2013 pC polarimeter detector instabilities

Instabilities seen in:

- Gain (pulse height / MeV)
  measured with 5.5 MeV α's at ends of RHIC fills
- Bias leakage current I_{bias} (V_{bias} = 110 V)

Correlations:

- Instabilities ↔ RHIC beam operation
- Gain $\propto 1/I_{bias}$
- Instabilities ↔ carbon measurements
  ~MHz of ~1 MeV carbon nuclei

No plateau in gain vs. V_{bias}

4 pC (proton-carbon) polarimeters:

- 6 Si strip detectors per polarimeter; 12 strips per detector
- Mostly shown here: average gain per detector
  total detector leakage current I_{bias}

Changes in 2013

Summary of changes (probably not exhaustive)
between pre-2013 ('old') and 2013 ('new') implementation:

Detectors:

- Old: strips 2mm wide × 10 mm long
- New: strips 1mm wide × 15 mm long
- New guard ring much narrower

Ceramic board:

- Old: bare ceramic board; ground traces between each signal trace, each bonded to guard ring;
- New: board coated with conductive material at ground; only couple of bonds guard ring ↔ ground plane; *very* narrow gap between bias supply trace ↔ ground

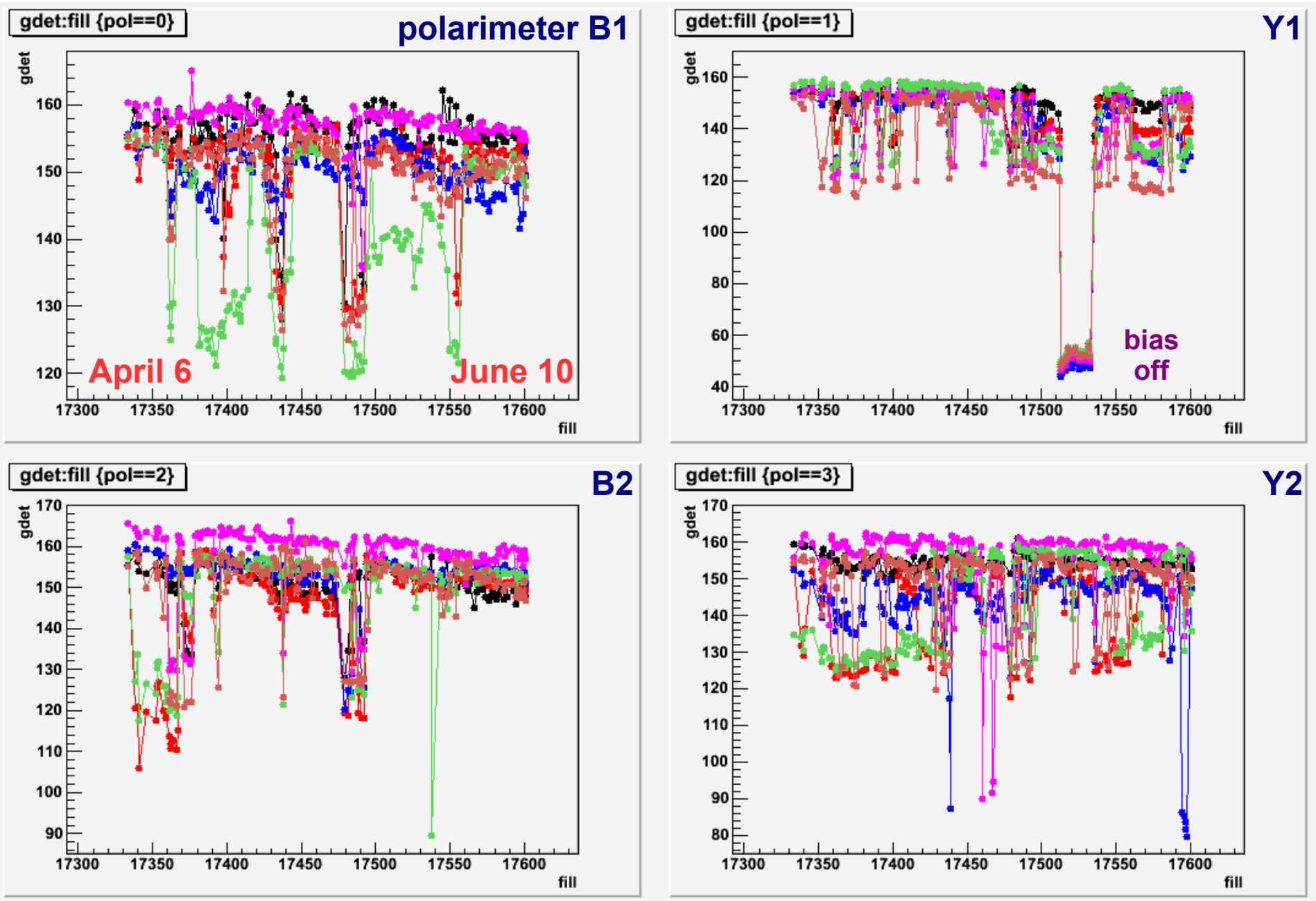
Unchanged:

- Mechanical installation and positioning
- Bias voltage supply and leakage current readout
- Front end preamp and signal readout

α-gain vs. RHIC fill

- Gains vary up to 25-30%, varying by detector:

measured at ends of RHIC fills

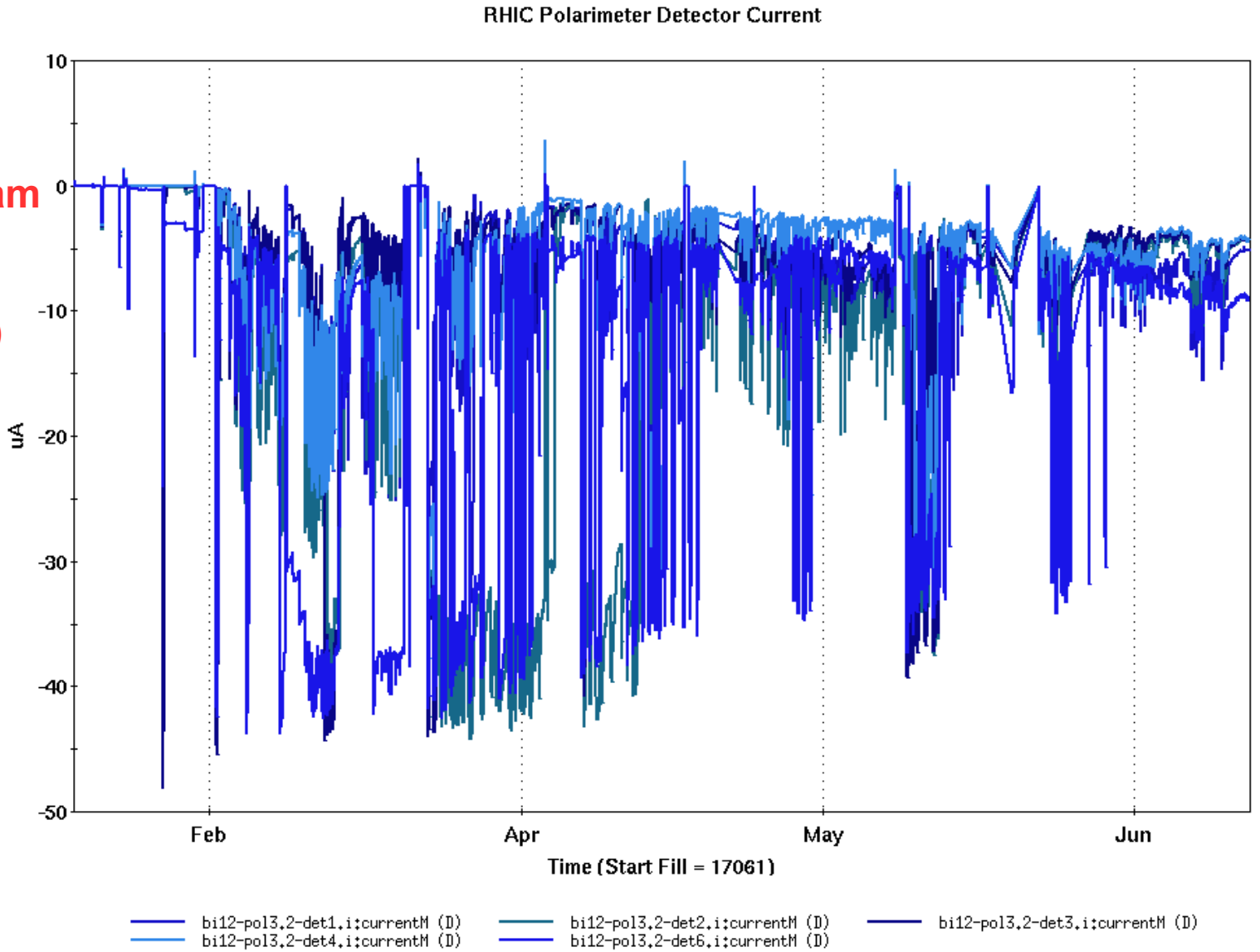


I_{bias} vs. date: polarimeter B2

other polarimeters on extra slides

- All 6 detectors large variations (few μA is “normal”)
- Magnitude of variations differs by detector

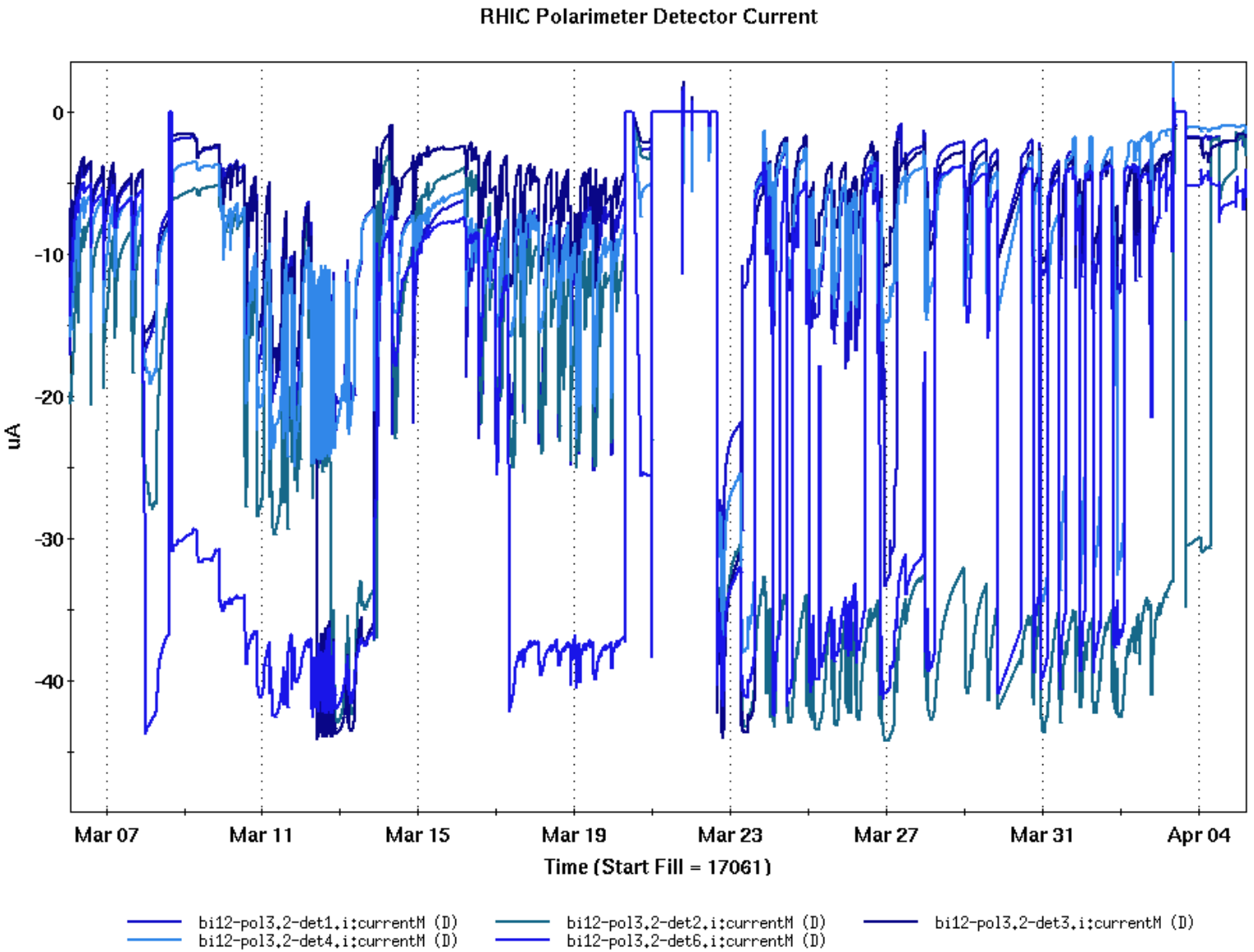
before beam operation few μA (“normal”)



after beam operation few μA (“normal”)

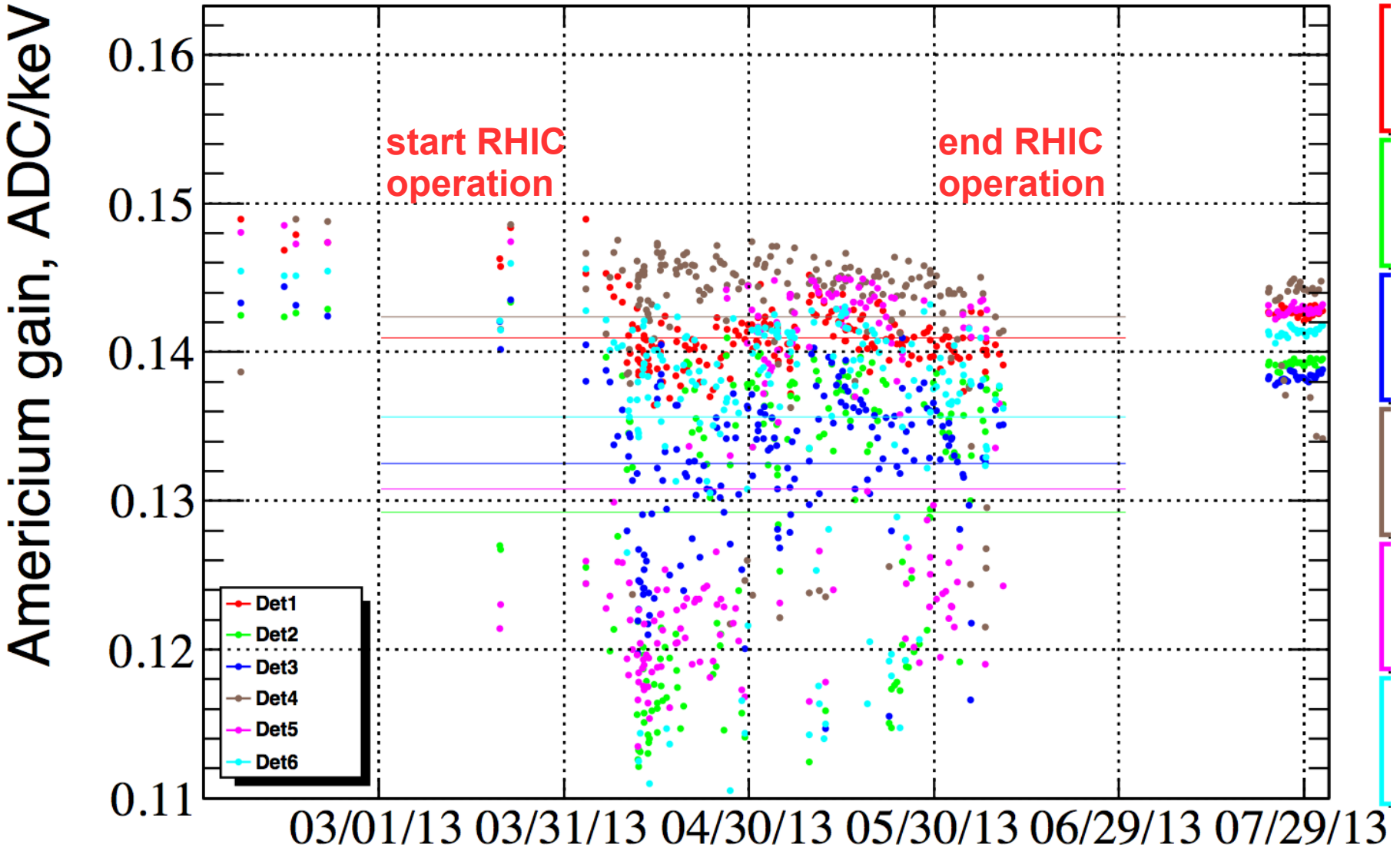
I_{bias} vs. date: B2 zoom (1 month)

- Short term variations each RHIC fill (~10 hours)
- Longer term excursions several days



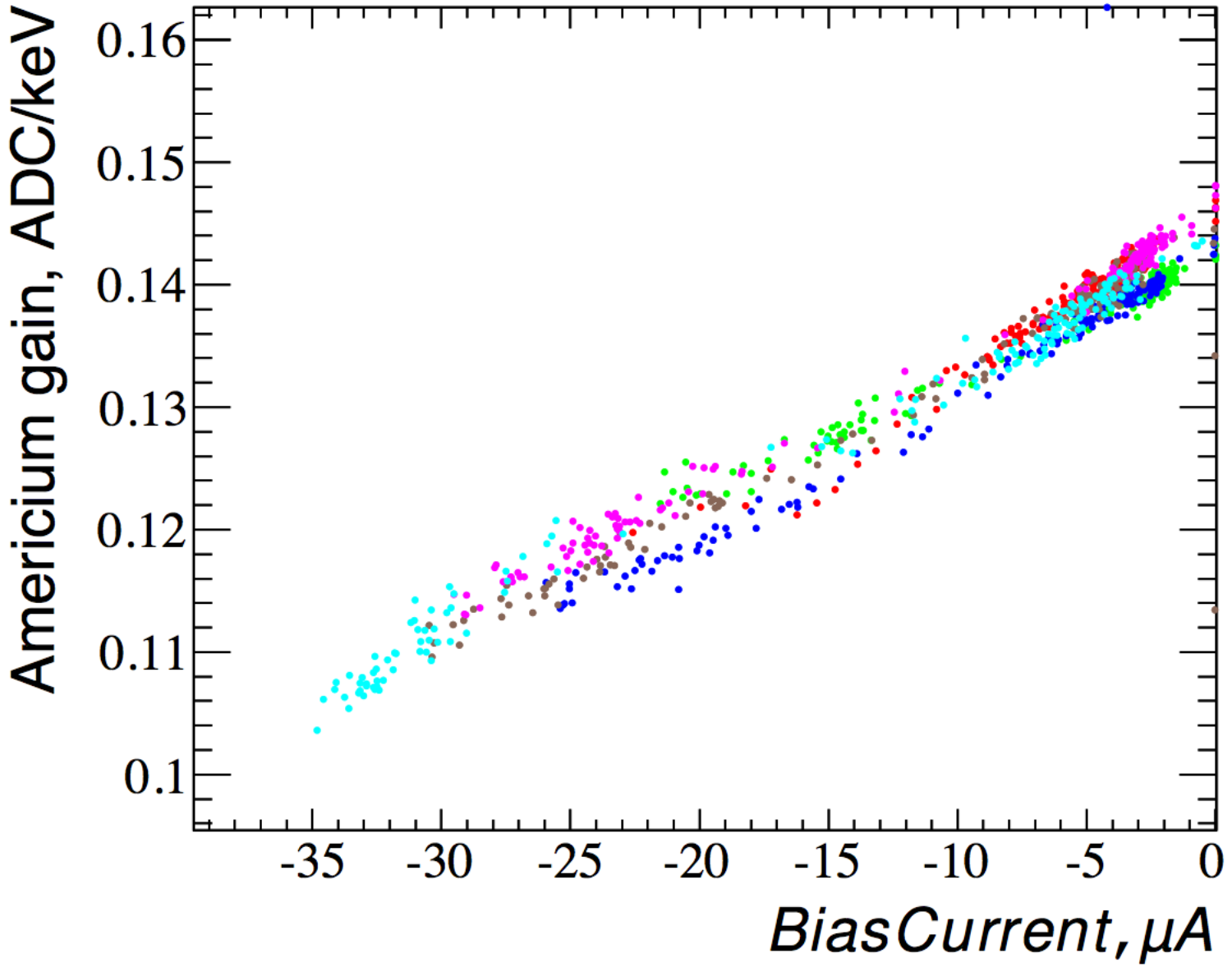
α-gain vs. date

- Gains returned to stable values after RHIC operation
- Small gain loss after 3 months exposure, “normal” radiation damage



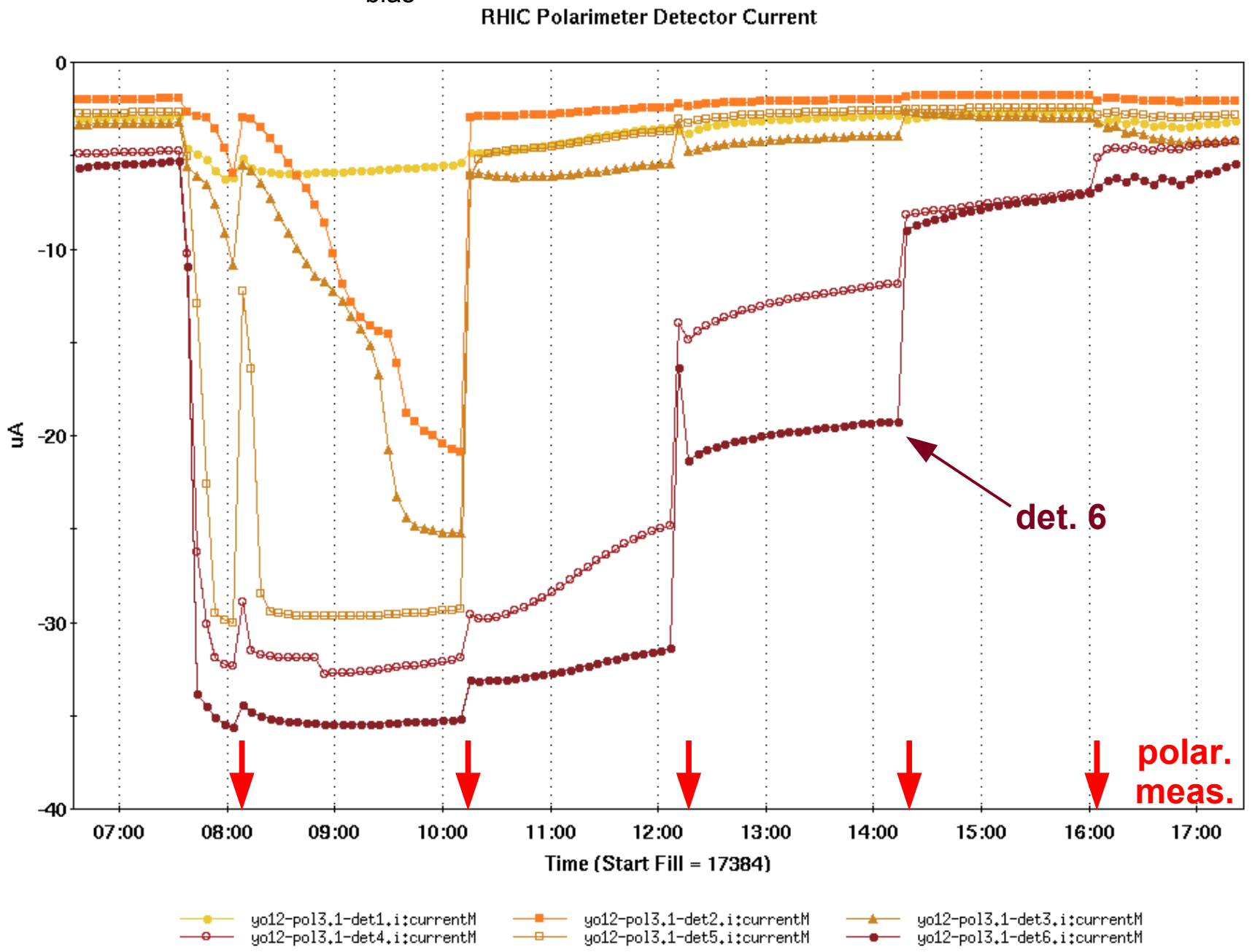
α-gain vs. I_{bias}

- Gain dropped with increasing (negative) I_{bias}



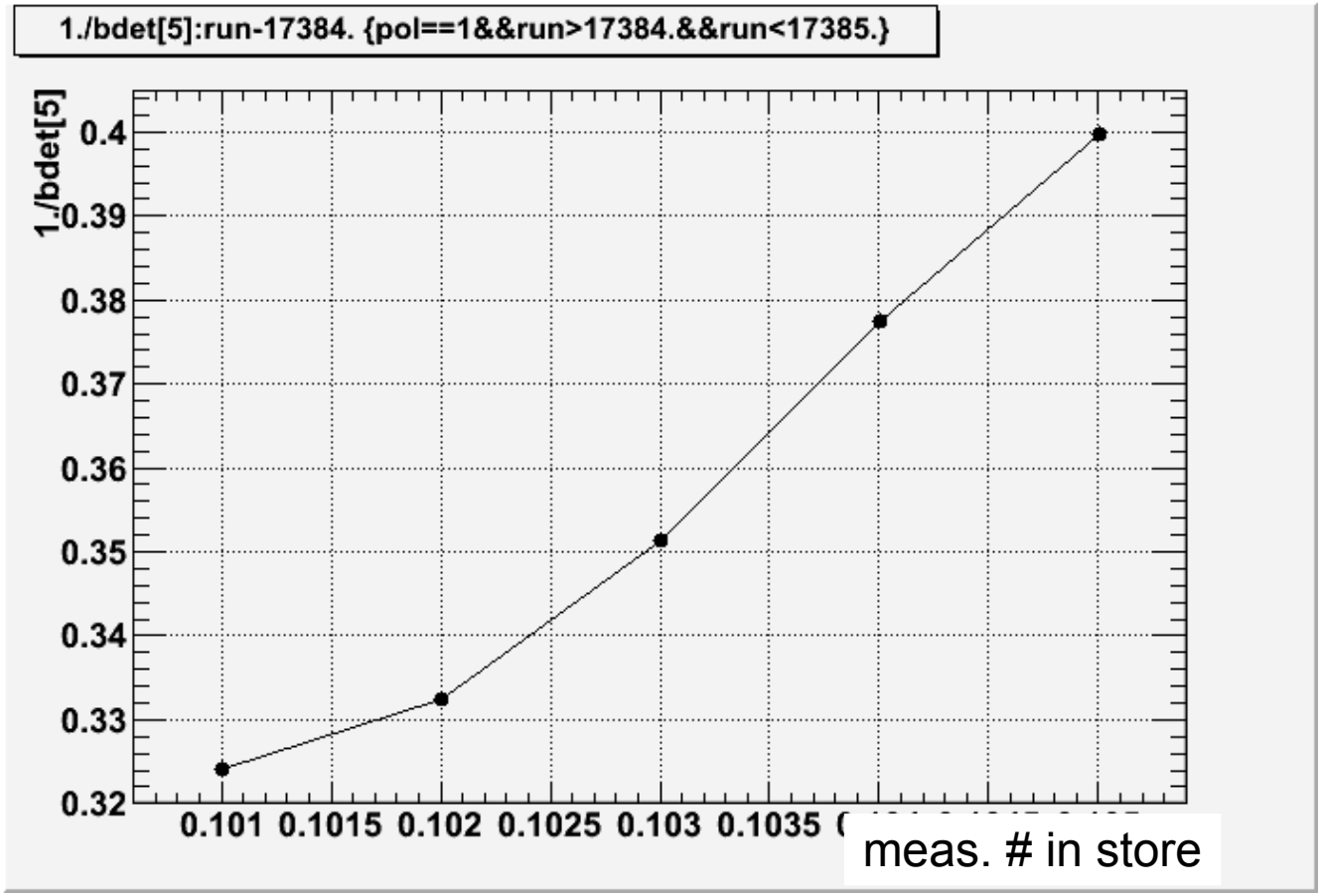
I_{bias} vs. time (17 hr.): fill #17384 Y1

- Drops (some big) in I_{bias} each polar. measurement:



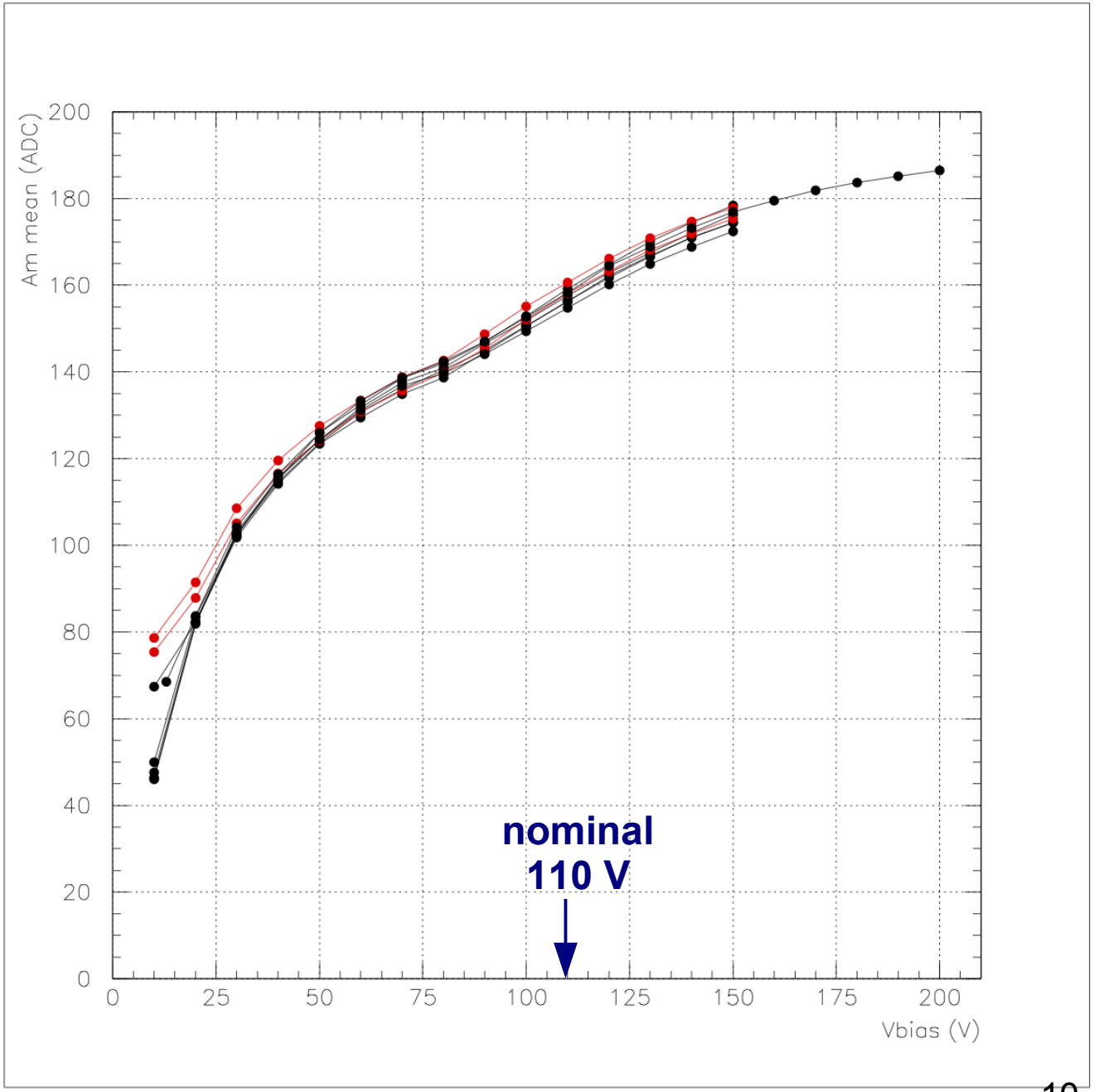
1/b ∝ gain: fill #17384 Y1 det. 6

- 5 measurements @ 255 GeV, every ~2 hours
- > 20% Carbon gain change (upwards) as I_{bias} dropped:



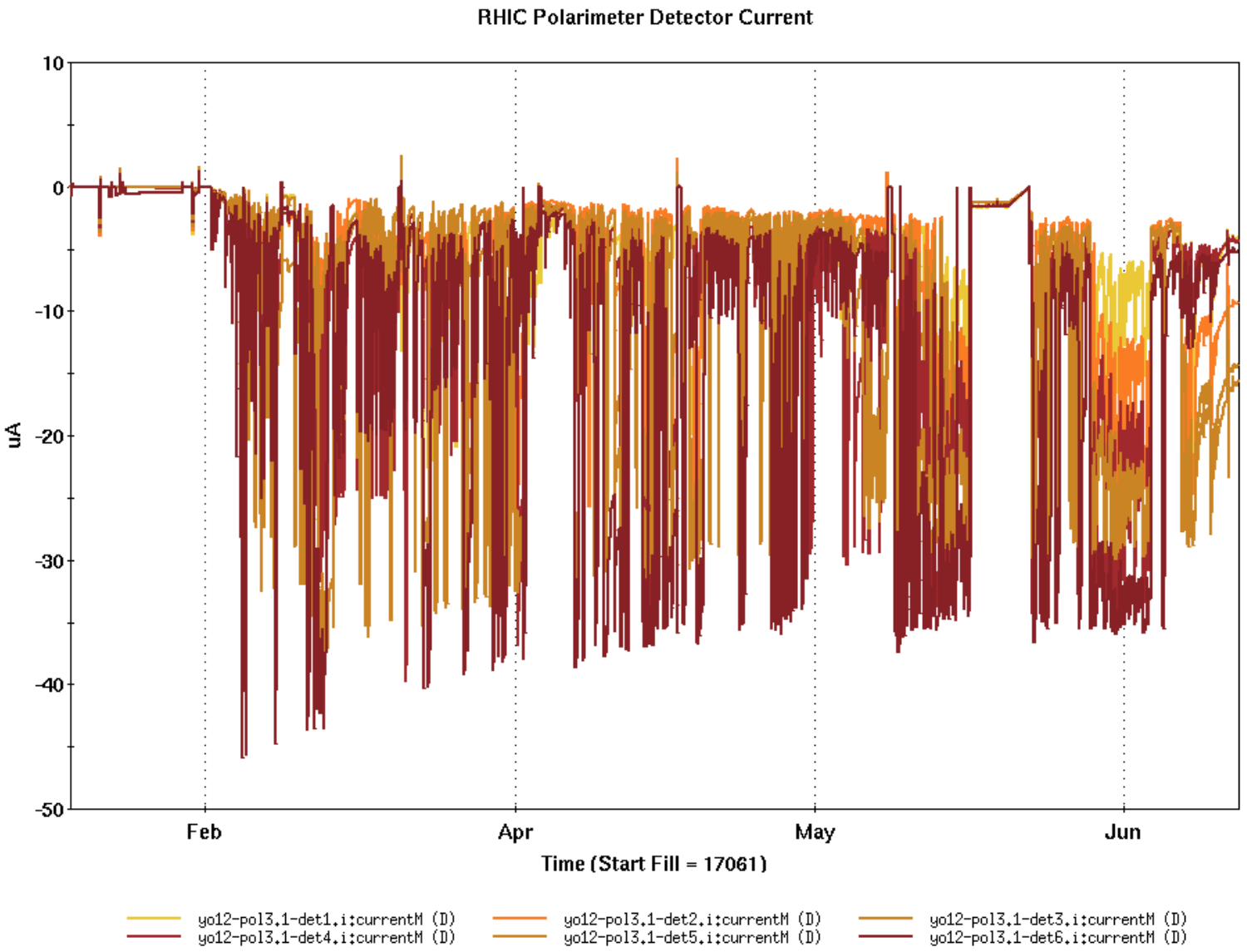
α-gain vs. V_{bias}

- **NO PLATEAU**
- **BLACK** = detectors after Run13 exposure
- **RED** = new (unexposed) detectors

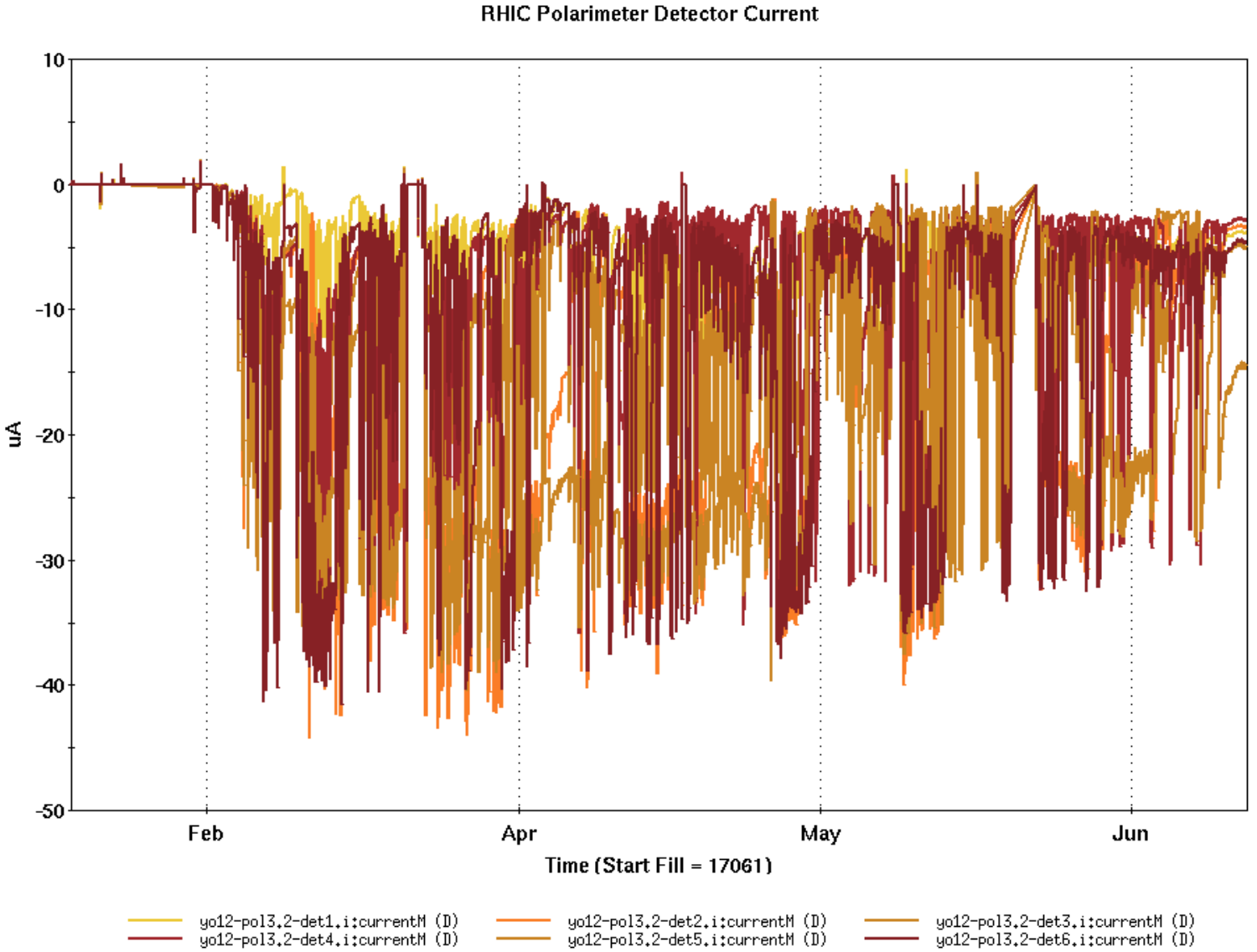


Extras

I_{bias} vs. date: Y1



I_{bias} vs. date: Y2



I_{bias} vs. date: B1